

NAVAL WAR COLLEGE  
Newport, RI

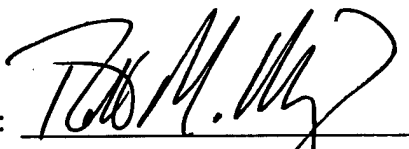
DOMINANT BATTLESPACE KNOWLEDGE: CONSIDERATIONS FOR  
THE COMMANDER

By

Robert D. McMurry  
Major, United States Air Force

A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Department of Joint Military Operations.

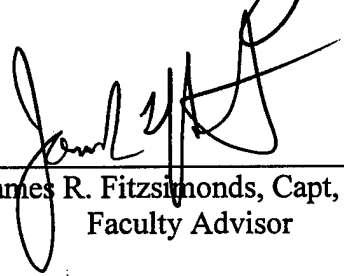
The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.

Signature: 

13 February 1998

DISTRIBUTION STATEMENT A

Approved for public release  
Distribution Unlimited

  
James R. Fitzsimonds, Capt, USN  
Faculty Advisor

## REPORT DOCUMENTATION PAGE

|  |                       |   |            |
|--|-----------------------|---|------------|
| 1. Report Security Classification: UNCLASSIFIED  |                       |   |            |
| 2. Security Classification Authority:  |                       |   |            |
| 3. Declassification/Downgrading Schedule:  |                       |   |            |
| 4. Distribution/Availability of Report: DISTRIBUTION STATEMENT A: APPROVED FOR<br>PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED.   |                       |   |            |
| 5. Name of Performing Organization: JOINT MILITARY OPERATIONS DEPARTMENT   |                       |   |            |
| 6. Office Symbol:<br>NWC Code 1C   |                       | 7. Address: NAVAL WAR COLLEGE<br>686 CUSHING ROAD<br>NEWPORT, RI 02841-1207 |            |
| 8. Title (Include Security Classification):<br>Dominant battlespace knowledge: Considerations for the Commander. (UNCLASSIFIED)  |                       |   |            |
| 9. Personal Authors:<br>Robert D. McMurtry, Major, United States Air Force   |                       |   |            |
| 10. Type of Report: FINAL  |                       | 11. Date of Report: 13 February 1998  |            |
| 12. Page Count: 20   |                       |   |            |
| 13. Supplementary Notation: A paper submitted to the Faculty of the NWC in partial<br>satisfaction of the requirements of the JMO Department. The contents of this paper<br>reflect my own personal views and are not necessarily endorsed by the NWC or the<br>Department of the Navy.  |                       |   |            |
| 14. Ten key words that relate to your paper:<br>dominant battlespace knowledge coercion asymmetric technology revolution in military affairs   |                       |   |            |
| 15. Abstract:<br>The information age, and an accompanying revolution in military affairs, has the potential to provide U.S. forces with<br>dominant battlespace knowledge resulting from information superiority. While the benefits to the commander would be<br>significant, the development of relative superiority in situational awareness will not go unnoticed by the enemy. While it may<br>provide advantageous deterrent and coercive capabilities, dominant battlespace knowledge will not necessarily prevent hostilities.<br>Commanders should expect the enemy to pursue asymmetric strategies including insurgencies, terrorism, and the use of<br>weapons of mass destruction to overcome the technological advantage of the United States. At the same time the enemy may<br>introduce technology into his own forces to improve his situation awareness and precision engagement capabilities. The end result<br>of technological advances of both sides may be increased weapons lethality, and increased involvement in prolonged conflicts and<br>military operations other than war.<br>Dominant battlespace knowledge will also create challenges to conventional military leadership. The goal of dominant battlespace<br>knowledge is to lift the fog of war. While the commander's understanding of the battle situation may improve, the existence of<br>dominant battlespace knowledge will create new and complex challenges. |                       |   |            |
| 16. Distribution /<br>Availability of<br>Abstract:   | Unclassified<br><br>X | Same As Rpt   | DTIC Users |
| 17. Abstract Security Classification: UNCLASSIFIED   |                       |   |            |
| 18. Name of Responsible Individual: CHAIRMAN, JOINT MILITARY OPERATIONS DEPARTMENT   |                       |   |            |
| 19. Telephone: 841-6461  |                       | 20. Office Symbol: C  |            |

## ABSTRACT

The information age, and an accompanying revolution in military affairs, has the potential to provide U.S. forces with dominant battlespace knowledge resulting from information superiority. While the benefits to the commander would be significant, the development of relative superiority in situational awareness will not go unnoticed by the enemy. While it may provide advantageous deterrent and coercive capabilities, dominant battlespace knowledge will not necessarily prevent hostilities.

Commanders should expect the enemy to pursue asymmetric strategies including insurgencies, terrorism, and the use of weapons of mass destruction to overcome the technological advantage of the United States. At the same time the enemy may introduce technology into his own forces to improve his situation awareness and precision engagement capabilities. The end result of technological advances of both sides may be increased weapons lethality, and increased involvement in prolonged conflicts and military operations other than war.

Dominant battlespace knowledge will also create challenges to conventional military leadership. The goal of dominant battlespace knowledge is to lift the fog of war. While the commander's understanding of the battle situation may improve, the existence of dominant battlespace knowledge will create new and complex challenges.

# **DOMINANT BATTLESPACE KNOWLEDGE: CONSIDERATIONS FOR THE COMMANDER**

## **INTRODUCTION**

The Joint Chiefs of Staff vision of future operational concepts, Joint Vision 2010, has a framework of four primary themes: dominant maneuver, precision engagement, focused logistics, and full-dimensional protection. "The basis for this framework is found in the improved command, control, and intelligence which can be assured by information superiority."<sup>1</sup> Information superiority takes advantage of the on-going information revolution to provide economy of force. This economy of force will result from what many are calling a revolution in military affairs. This revolution brings three key capabilities to the warfighting commander: dominant battlespace knowledge, real-time sensor-to-shooter information transfer, and precision engagement. This paper focuses on the effects of dominant battlespace knowledge. Significant improvements in battlespace awareness will undoubtedly increase the combat effectiveness of U.S. armed forces, especially when accompanied by sensor-to-shooter information transfer, and precision engagement. However, dominant battlespace knowledge will also present new challenges to the operational commander.

## **A LOOK AT THE FUTURE**

*By 2010, we should be able to change how we conduct the most intense joint operations. Instead of relying on massed forces and sequential operations, we will achieve massed effects in other ways. Information superiority and advances in technology will enable us to achieve the*

*desired effects through the tailored application of joint combat power.*

*-- Joint Vision 2010*

The future described in Joint Vision 2010 is more than just an idea of what warfighting can become. Rather, it is a guidepost by which the Department of Defense is establishing military requirements. These requirements are the basis for DOD modernization efforts. The underlying theme behind these new requirements is economy of force. Economy of force in a sense is "a recapitulation of the principles of objective, offensive, mass, and security."<sup>2</sup> The need to downsize the military while still maintaining a strong combat capability demands the use of leveraging technologies, or force multipliers. The information revolution is conveniently providing the means to create the capabilities. Modernization will create the weapons of tomorrow, and they in turn will affect the manner in which the United States fights wars.

According to Admiral William Owens, former Vice Chairman of the Joint Chiefs of Staff, the requirements and programs in place today are creating a "system of systems" that will make a "qualitative jump in our ability to use military force effectively."<sup>3</sup> In fact, he contends the change in the way the United States will fight wars is the result of three separate revolutions: 1) the change in world affairs brought about by the fall of the Soviet Union, 2) the reduction in the U.S. defense budget, and 3) the often mentioned revolution in military affairs.<sup>4</sup>

## THE REVOLUTION IN MILITARY AFFAIRS

*Not even war will guarantee that all military organizations will recognize and exploit a military revolution, or understand a revolution in all its dimensions.*

*-- Andrew Krepinevich, "Cavalry to Computer: The Pattern of Military Revolutions"*

There are many definitions of what constitutes a revolution in military affairs.

But generally authors agree that it includes changes in technology, war fighting doctrine, and organization that together produce a quantum leap in military capability.

Krepinevich suggests that since approximately 1400 AD there have been some ten separate revolutions in military affairs.<sup>5</sup> Alvin and Heidi Toffler add the requirement for major social change to accompany the changes in doctrine, technology, and organization and therefore suggest that there have been only two.<sup>6</sup> Regardless of the degree of social change, the end result is a huge increase in military effectiveness.

Though it is not given the same weight and consideration by most of the United States' allies,<sup>7</sup> the consensus is that a revolution in military affairs is underway. If this is the case, then about what characteristics of a revolution in military affairs should commanders be particularly concerned?

Three key issues come to the fore. First, the revolution in military affairs is dependent upon intellectual and doctrinal change. That is, technology alone will not bring about a revolution in military affairs. This implies that there are significant challenges beyond merely implementing new technology: challenges the commander must anticipate and address.

The current revolution in military affairs focuses on the use of radically improved information technology. The information and computer age is upon us and it will radically change the way wars are fought. One result of the revolution will be increased situation awareness, termed by Martin Libicki as dominant battlespace knowledge.<sup>8</sup> The second result will be improvements in command, control, communications, and computers to facilitate information transfer. The discussion often focuses on sensor-to-shooter fusion, meaning the ability to move relevant data from a sensor to a weapons delivery platform in real-time and use that information to effectively attack the enemy. Third is precision engagement. The Gulf War hinted at the dramatic effect of precision weapons, yet most of the weapons used in the war were not precise. Precision engagement will bring pinpoint accuracy *with* standoff delivery.

Each of these three products of the revolution in military affairs, dominant battlespace knowledge, sensor-to-shooter fusion, and precision engagement, will provide both opportunities and challenges for the operational commander. The opportunities will come in the form of dramatically increased military capabilities. The challenges will come in trying to deal with the changes in thinking and organization necessary to make the new technologies work.

### DOMINANT BATTLESPACE KNOWLEDGE

*Weigh the situation, then move.*

*-- Sun Tzu, The Art of War.*

Dominant battlespace knowledge is situational awareness regarding the disposition, location, and orientation of all forces, with enough precision to target hostile forces with the best munitions to destroy them. That is, the location of an enemy tank,

for example, must be known to within the lethal radius of the anti-armor munition expected to destroy the tank.<sup>9</sup> *Dominant* means a significant relative advantage in situation awareness. Barry Watts equates this relative advantage to a relative reduction in the Clausewitzian friction of war, resulting in an improved probability to achieve mission objectives.<sup>10</sup> *Knowledge* implies that the situation awareness information is accessible, understandable, and useful to the commander in developing a more complete picture of the battlespace. By providing the commander with a clearer picture of the battlespace and enabling rapid and precise targeting, dominant battlespace knowledge provides operational opportunities to employ force when and where it will be most decisive. This capability could change the outcome of the battle, enabling a successful defense against a larger force, or in the case of the offensive, enabling a decisive victory, which may even shorten the conflict.

There are many technical issues associated with the definition and attainment of dominant battlespace knowledge. How much situation awareness can be attained? How useful will the information be? What constitutes dominance in terms of battlespace knowledge? There are many more questions to be answered. However, in order to better focus on the effects, and moreover on the challenges resulting from dominant battlespace knowledge once it has been achieved, the following assumptions are made:

1. Dominant battlespace knowledge can be achieved to provide real-time situation awareness information for at least a 200nm by 200nm region.
2. Dominant battlespace knowledge network systems will be reliable and available.



3. Dominant battlespace knowledge will include the location of both friendly and enemy conventional forces.
4. Dominant battlespace knowledge will support effective rapid response and precision engagement capabilities.
5. Although enemy situation awareness may also improve dramatically, U.S. battlespace knowledge will be better than what is achievable by the enemy.

## DOMINANT BATTLESPACE KNOWLEDGE AND THE RECIPROCAL

### NATURE OF WAR

*The knowledge required in war is very simple, but at the same time it is not easy to apply.*

*-- Carl Von Clausewitz, On War.*

Many detractors of the information revolution and its positive effects on U.S. military power suggest the wide availability of information technology will work to reduce the U.S. advantage. This argument has some merit in that it addresses the reciprocal nature of war. The United States should anticipate that the enemy will attempt to counter any U.S. technological advances by adopting offensive and defensive improvements and asymmetric strategies. The following paragraphs discuss some of the possible challenges accompanying dominant battlespace knowledge.

#### **Dominant Battlespace Knowledge and Coercion**

If U.S. forces could detect, track, identify, and target every hostile platform within a 200nm by 200nm region, they would achieve the dominance over conventional forces described in Joint Vision 2010. It is plausible to reach this capability.<sup>11</sup> However, would

the dominance of conventional forces be without problems? Certainly states desiring to coerce their neighbors find the use of conventional forces convenient. Conventional forces are visible evidence of intent and can effectively intimidate a weaker state to comply in short order. The United States removing this capability does not eliminate the desire of that state to impose its will on its neighbor. The logical resort then is to use some means other than conventional forces.

In the absence of effective conventional forces (presumably neutralized by the involvement of the United States with its precision weapons and dominant battlespace knowledge) states will certainly be more prone to use unconventional means. Asymmetric strategies using insurgency, terrorism, and other slower, but difficult-to-counter strategies will become more prevalent. With conventional force superiority, the probability of U.S. involvement in counter-insurgency or other military operations other than war (MOOTW) increases.<sup>12</sup> The probability of an opposition state employing chemical, biological, or nuclear weapons increases as well. Therefore, it is critical to continue efforts to counter proliferation of weapons of mass destruction.

The enemy, incapable of winning in a conventional arena, will also work to erode U.S. popular support. To accomplish this he may, as did the Viet Cong, attempt to kill American troops, terrorize the local populace, and protract the war in hopes of destabilizing the local government and eroding the U.S. public's support for the war effort. Enemy forces may also target allies in attempts to fracture important coalitions. To counter American technology, the enemy may invest in limited numbers of high tech systems, like the Mujhahadeen used Stinger missiles in Afghanistan. They may also

work to limit the effectiveness of U.S. technology through the use of camouflage & strategic deception.<sup>13</sup>

Emphasis on MOOTW must remain high. The difficulties associated with these types of missions will probably not be overcome by technology. For instance, improving battlespace awareness does little to clarify political mission objectives and end states. In employing unconventional methods the aggressor may find ways to "mask indicators of military activity."<sup>14</sup> The rationale for moving to unconventional methods stems from the likely difficulty of any situational awareness system to differentiate between belligerents and civilians. It is relatively simple to identify a moving tank, target it, and destroy it and its occupants. It is quite another to determine if the occupants of a pickup truck are civilians or combatants.

#### **Locating Threats: Impacts on the Rules of Engagement**

Dominant battlespace knowledge will also bring challenges in the area of rules of engagement. In particular, the inherent right of self defense may become an issue when fielded forces are faced with a foe with beyond-visual-range weapons. It will then be necessary for the commanders to determine hostile intent. Merely knowing the location of forces, especially in a MOOTW environment, may not be enough to allow engagement; and it may not be enough to determine hostile intent. If the commander must notify forces or contact them to determine hostile intent it may expose troops to more dangerous conditions than one would like.

In MOOTW, free fire conditions are not likely to occur. The end-result will be that U.S. forces will, at increased risk to themselves, limit firepower through the rules of engagement in order to prevent casualties to noncombatants. The effect will be similar to

that seen during early use of radar air-to-air missiles. Though these missiles were capable of downing an enemy aircraft beyond visual range, the pilots were forced to visually identify their foe in order to ensure against fratricide. The end result was that "beyond-visual-range kills were, for the most part, only feasible under very carefully controlled conditions in which special equipment for identifying friend from foe was available."<sup>15</sup>

Given the difficulty in identifying noncombatants in MOOTW, the rules of engagement will likely be similar to those used today, as will the methods of operating. In Bosnia today, the NATO rules of engagement allow a soldier to open fire on someone who fires or aims a weapon at him, attempts to use explosives against troops or property, or who deliberately drives a vehicle at troops or property.<sup>16</sup> Situational awareness systems designed to counter conventional forces over large areas provide little to prevent these dangerous situations in a conflict short of war. While operations can be conducted effectively under these conditions, the commander must be prepared to operate with less relative advantage.

The rules of engagement provide the bridge between policy and operations. As such, the constraints they impose on friendly forces help to control the level of violence while allowing mission success and force protection. However, these constraints may appear to prolong the conflict. If so there will likely be political fallout from the lack of effectiveness of high tech systems and the probable casualties resulting from reduced relative advantage.

## **Advantage of the Defense**

Moving vehicles and aircraft are relatively easy to track with radar employing either moving target indication or Doppler techniques. Therefore, battlespace knowledge is more achievable against moving targets. Precision engagement, on the other hand, is complicated by target motion and is easier against stationary targets. An enemy may be able to develop high quality (though less capable) situation awareness systems and precision engagement capabilities. If enemy precision engagement capabilities provide a high enough probability of kill against moving targets, detection by the enemy, and by extension movement, become fatal. When detection becomes fatal, the defensive regains its stature as a preferred approach to battle. This is especially true if lack of movement, combined with camouflage, can significantly reduce the enemy's ability to detect friendly forces.

The commander's challenge comes in that as operations become more defensive the conflict tends to protract. In fact, it may even become impossible to achieve mission objectives without sustaining very high casualties. Lengthy conflicts risk loss of U.S. public support. At the same time, U.S. casualties tend to have the same effect. The operational commander will have to balance these risks to be successful. Tactics and systems to counter situational awareness, such as stealth and camouflage, may remain high priorities in order to facilitate offensive operations and shorten the conflict while minimizing casualties.

## **OTHER CONCERNS FOR THE OPERATIONAL COMMANDER**

*"To begin with, clear thought demands that we keep one point in mind: of the weight, the burden, the resistance – call it what you like – that challenges the psychological*

*strength of the soldier, only a small part is the direct result of the enemy's activity, his resistance, or his operations."*

*-- Carl Von Clausewitz, On War.*

### **Dominant Battlespace Knowledge: a Two-way Challenge to Leadership**

Dominant battlespace knowledge challenges decentralized execution by providing the senior commander with such a detailed picture of the battlespace that he may feel compelled to get involved with the execution of the mission. At the same time, dominant battlespace knowledge challenges central control. In order to execute coherent operations and multiple simultaneous operations at the high tempo needed to capitalize on the relative advantage provided by dominant battlespace awareness, the senior commander may need to relinquish some of the control he exercises today.<sup>17</sup>

#### *The Challenge to Decentralized Execution*

Dominant battlespace knowledge may create an environment fostering higher command involvement in execution of operations. If situation awareness sensors, communications, or display systems are limited, it is possible that the commander will have a more complete picture of the battlespace than his subordinates. This begs the question. Is it a bad thing for the senior commander to be more involved in the battle? Certainly it seems in conflict with current thinking that decision making should take place at the lowest command level appropriate. However, if his knowledge of the battlespace is equal or better to that of the lower echelon commanders, there may be certain advantages to the senior leader's involvement.

Generally the senior commander brings considerably more experience to the fight. Furthermore, he was likely chosen for his position for his skill and acumen. Even if these

advantages are not enough to validate his involvement, his involvement will likely seem mandatory given his responsibility for force protection. The senior commander will be held accountable for any mishaps or casualties that might result due to his inaction if indeed he did have an adequate knowledge of the battle situation to act. The assessment of what knowledge he had at the time of any mishap will surely be determined via after the fact analysis of mission data from the situational awareness systems. Recordings of this type tend to be very complete regarding the facts of the battle, even if they do miss the stress and fog of war.

Therefore, it is easy to see why the upper levels of command may become more involved in decisions which today are left to lower level commanders. It will be a challenge to these senior commanders to develop an environment of trust so subordinates do not react unfavorably when this occurs. This sense of trust will have to work the other way also to help the senior commander avoid unnecessary involvement in execution.

### *The Challenge to Centralized Control*

While the senior commander may feel compelled to get involved in execution operations, maintaining the battle management picture might actually degrade rapid response operations. Given limited resources, the assets used by the commander to maintain his battlespace knowledge may be the same assets needed to coordinate attacks on precision targets. "Historically, the battle manager has monopolized tasking of special sensors, leaving the shooter with inadequate information to carry out the mission effectively."<sup>18</sup>

Application of new technology to military operations will likely suffer from the same difficulties as application of technology in industry. The availability of information

demands faster action at lower levels. This challenges the traditional organization. Most companies, when introducing new technology information systems, have had trouble when trying to apply the new technology to the old processes. It is necessary, in most cases, to reengineer the process (develop a new concept of operations) to take advantage of the new technology.<sup>19</sup> This is entirely consistent with the requirements of a revolution in military affairs. Doctrine, technology, and organization must change to complete the revolution.

### **Theater Assets and Expanding the Box**

Admiral Owens speaks of the 200nm by 200nm box within which the operational commander would have complete knowledge of the disposition of friendly and enemy forces.<sup>20</sup> This size of battlespace would sufficiently cover many battle areas including the Korean and Kuwaiti theaters of operations, but it likely would not suffice in Iran or the South China Sea. The question arises then, how is the system degraded if you expand the box?<sup>21</sup> It is safe to assume that there would be some degradation.

Achieving the revolution in military affairs will require a major investment – the National Defense Panel estimated five to ten billion dollars in additional investment through 2008.<sup>22</sup> Given downsizing and its accompanying fiscal austerity, this is a *huge* investment. Therefore, it is reasonable to expect that the commander will be faced with at least some resource limitations. Lack of resources in this case equates to lack of situational awareness.

If a second major conflict were to develop, the operational commander's allocation of forces to two theaters would be greatly dependent upon the situational awareness assets available in each theater, and the associated degree of battlespace



knowledge anticipated. In deciding which forces to use in each theater, the commander would still consider mission, enemy, available forces, terrain and weather, and time available as well as strategic lift, prepositioned assets, and available host nation support.<sup>23</sup> However, the availability of situational awareness systems, or their unavailability may result in significant changes to the force mix. Because of the leverage provided by dominant battlespace knowledge, the commander might send a smaller force to the higher priority effort if that region had sufficient intelligence, surveillance, reconnaissance, and command and control assets. The secondary effort, with reduced battlespace knowledge might take more forces to ensure mission success, or to hold until forces from the first region became available.

#### **Will the Fog of War Lift or Only Change in Nature?**

The fog of war has historically dealt with lack of information. Most often that missing information involved the location and disposition of enemy forces. If the system of systems described by Admiral Owens comes to fruition, will the fog be lifted? While revolution in military affairs enthusiasts and Joint Vision 2010 support the view that it will be much clearer, recent history suggests that the fog may merely change form.

In three events in recent years, command confusion and misinterpretation of situational information has led to catastrophe: the attack of the U.S.S. Stark by an Iraqi Mirage employing an Exocet missile, the downing of an Iranian airliner by the U.S.S. Vincennes, and the downing of two United Nations Blackhawk helicopters by U.S. F-15s. In all three cases friendly forces had the information necessary to prevent the tragedy, yet failed to act on that information. The information had not been synthesized into knowledge. The Stark was aware of the Iraqi Mirage, but treated it without due regard.<sup>24</sup>

The Vincennes may have confused the Airbus that had just taken off with F-14 aircraft on the ground in Iran.<sup>25</sup> The AWACS\* crew apparently knew of the presence of friendly force helicopters in Northern Iraq, but failed to correct the mistaken hostile identification made by the F-15 pilots. The common thread is the availability of threat information and the failure to act upon it. Creating knowledge from information will continue to be a challenge, especially as the amount of information available to the commander and his subordinates increases.

Hopefully the United States is learning from its mistakes, but as more and more information on the battlespace is provided to our forces, commanders should anticipate more problems such as these. A difficult task for the senior commander will be to develop leaders capable of integrating the information provided and evaluating it in light of the current operational capability of the sensor and command and control networks providing the information. Certainly, this ability alone will not make a good commander. In the future, the commander's judgement, and his vision of the course of battle will continue to play a significant role in the outcome of the conflict. Technology will help to provide information, but it will be up to the commander to organize that information and act on it to achieve the desired end state.

## CONCLUSIONS

Dominant battlespace knowledge resulting from information superiority is the future envisioned in Joint Vision 2010. The benefits to the commander are significant. Dominant battlespace awareness is the enabler for precision engagement and it greatly

---

\* AWACS is the E-3A Airborne Warning and Control System aircraft.

improves the efficiency and effectiveness of combat forces. However, the development of dominant battlespace knowledge will not go unnoticed by the enemy. While this may provide advantageous deterrent and coercive capabilities, it will not necessarily prevent hostilities.

Commanders should expect the enemy to pursue asymmetric strategies to minimize the effectiveness of technology while at the same time working to improve his own forces. Major technological advantages of the United States may make military operations other than war more prevalent. Generally protracted in their nature, these conflicts may seem even longer given expectations of both friendly forces and the American public regarding the supremacy of technology. Should the enemy develop sufficient technology, the conflict may be lengthened even more by the need for U.S. forces to be defensive.

The availability of the system of systems will create challenges to conventional military leadership. While, the appropriate level of commander involvement may increase in some instances, it is more likely the senior commander will have to relinquish some control in order to maintain the pace of operations and truly exploit the battlespace awareness advantage.

The nature of war will probably not change; there will be fog of war. The most likely change will be in the nature of the fog. Recent history suggests that having information available does not ensure that operations will succeed. The great challenge of the future may be to create knowledge from information. The reciprocal nature of war, however, suggests that the knowledge itself will create even more challenges.

## NOTES

<sup>1</sup> Joint Chiefs of Staff, *Joint Vision 2010*. (Washington, D.C.), 19.

<sup>2</sup> Rear Admiral C. R. Brown, "The Principles of War," *Proceedings*, Vol. No. 75, No. 6, 1947, 630-631.

<sup>3</sup> Admiral William Owens, "The Emerging U.S. System of Systems." *Dominant Battlespace Knowledge*. <<http://198.80.36.91/ndu/inss/books/dbk/dbkch01.html>> (12 December 1997). 1.

<sup>4</sup> Ibid.

<sup>5</sup> Andrew F. Krepinevich, "Cavalry to Computer: The Pattern of Military Revolutions," *The National Interest*, Fall 1994, 31-36.

<sup>6</sup> Alvin and Heidi Toffler, *War and Anti War: Survival at the Dawn of the 21<sup>st</sup> Century*, (Boston, MA: Little, Brown, 1993), as referenced by Commander Graham Ramsay RN, "The Revolution in Military Affairs: A Primer for the Uninitiated," Strategic Research Department, Research Report 9-96, U.S. Naval War College, Newport, RI, 11.

<sup>7</sup> Commander Graham Ramsay RN, "The Revolution in Military Affairs: A Primer for the Uninitiated," Strategic Research Department, Research Report 9-96, U.S. Naval War College, Newport, RI, 1.

<sup>8</sup> Martin Libicki, "Dominant Battlespace Knowledge and Its Consequences," from <<http://18.80.36.91/ndu/inss/dbk>>, downloaded 12 Dec 97, 1.

<sup>9</sup> Libicki, 1.

<sup>10</sup> Barry D. Watts, Clausewitzian Friction and Future War, McNair Paper 52. Washington: National Defense University, Institute for National Strategic Studies, 1996), 86, 132-133.

<sup>11</sup> Libicki, 9-10.

<sup>12</sup> Ibid.

<sup>13</sup> Steven Metz and James Kievit, *The Revolution in Military Affairs and Conflict Short of War*, Strategic Studies Institute, Army War College, Carlisle Barracks, PA, 1994, 14-15.

<sup>14</sup> Ibid.

<sup>15</sup> Barry D. Watts, "Doctrine, Technology, and War" as presented at the Air & Space Doctrinal Symposium, Maxwell AFB, AL, 30 April – 1 May 1996. <<http://www.cdsar.af.mil/presentation/watts.html>> (12 Dec 97), 11.

<sup>16</sup> "Rules of Engagement," *Bulletin*, Joint Center for Lessons Learned, 19.

<sup>17</sup> Jeffrey R. Cooper, *Another View of the Revolution in Military Affairs*, Strategic Studies Institute, Army War College, Carlisle Barracks, PA, 1994, 33-35.

<sup>18</sup> U.S. Joint Chiefs of Staff, *Advanced Battlespace Information System (ABIS) Task Force Report, Volume IV, Sensor-to-shooter Working Group Results*, May 1996, p2-12.

<sup>19</sup> Ibid, 34.

<sup>20</sup> Admiral William Owens, "The Emerging U.S. System of Systems." *Dominant Battlespace Knowledge*. <<http://198.80.36.91/ndu/inss/books/dbk/dbkch01.html>> (12 December 1997). .

<sup>21</sup> Libicki, 8.

<sup>22</sup> U.S. Department of Defense, *National Defense Panel Final Report*, Washington D.C., 1997, 2.

<sup>23</sup> U.S. Army FM 100-5, *Operations*, p3-5.

<sup>24</sup> Brian C. Nickerson and Dario E. Teicher, "Factors that Affect Shipboard Operational Decision Making," Thesis, Naval Postgraduate School, Monterey, CA, 5-9.

<sup>25</sup> Ibid, 9-13.